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Study on Behaviour of Concrete Blocks with EPS and Partial Replacement of Fly ash and Quarry Dust

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Abstract— *We are developed a new structural concrete member by completely replacing coarse aggregate, fine aggregate. A study of concrete made with expanded polystyrene (EPS) beads as aggregate was carried out. Here, Fly ash partially replaced by cement was found the compressive and tensile strength of EPS concrete and then compared to conventional concrete M20.Old construction technique is being more costly due to loading, so light weight concrete is used. This paper reports the results of an experimental investigation into the engineering properties EPS concrete.*

Keywords— Expanded polystyrene, Fly ash, Quarry dust, M20 conventional concrete, Compressive strength, Tensile strength.

I. INTRODUCTION

Expanded polystyrene (EPS) is a rigid cellular plastic invented in Germany 1950. EPS beads are often used as the basis of packaging material. Currently millions of tons of waste polystyrene are produced in the world. It was produced harmful effect in ecosystem. This is leads to large amount of waste material which is not biodegradable. The polystyrene beads can be easily merged into mortar or concrete to produce light weight concrete. Light weight concrete can be used in various constructions such as carrying walls of low thermal conduction, bridge decks etc.

Fly ash is a pozzolanics material when mixed with lime (calcium hydroxide), pozzolanics combine to form cementicious compounds. Concrete containing fly ash becomes stronger, more durable, and more resistant to chemical attack. Pulverized fuel ash commonly known as fly ash, is comprised of the non-combustible mineral portion of coal. When coal is consumed in a power plant, it is first ground to the fineness of powder. It's having molten particles of silica, alumina and calcium. These particles solidify as microscopic, glassy spheres that are collected from the power plants exhaust before they can fly away.

Quarry dusts are also known as rock powders, rock flour. It consists of finely crushed rock processed by natural or mechanical means. The aim of this report is to achieve a mix design for light weight EPS concrete with enough high compressive strength so that it can be used in construction purposes.

II. MATERIALS

This experimentation were locally available by product materials are used. Its include cement (fly ash) as a binding agent, quarry dust as fine aggregates, EPS beads (Expanded polystyrene) as a coarse aggregates. Normal water was used for mixing and curing of entire work.

2.1 Cement

The Ordinary Portland Cement (OPC) cement was used.

2.2 Fly ash

Fly ash are also known pulverized fuel ash, is one of the coal combustion product.

Table.1: Properties of Fly ash

Sr. No.	Physical Property	Results
1.	Color	Whitish grey
2.	Bulk density	0.994(g/cm^3)
3.	Specific Gravity	2.29
4.	Moisture	3.14
5.	Particle size	6.92µm

2.3 Quarry dust

Quarry dusts are also known as rock powders, rock flour. It consists of finely crushed rock processed by natural or mechanical means.

2.4 Expanded polystyrene (EPS)

EPS balls as an aggregate instead of crushed stones used for regular concrete. Such as increase sound and thermal insulation of conventional concrete.

Table.2: Properties of EPS

Sr. No.	*Physical Property*	*Result*
1.	*Shape*	***Spherical***
2.	*Size*	***1.18-2.36(mm)***
3.	***Specific Gravity***	***0.011***

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Table.5: Mix proportion

TYPE II				
Water content (w/c)	Cement (kg)	Fly ash (kg)	Quarry dust (kg)	**EPS beads (kg)**
0.50	**0.7**	**0.3**	**1.5**	**3**

III. PROCEDURE

3.1 Batching and Mixing

Volume batching was done as per mix proportion.

IV. MIX PROPORTION

The substantial properties of ingredients are determined. The mix proportion for conventional M20 grade concrete is deriving as per IS: 10262-1982.

Assumed w/c ratio = 0.50,

Table.3: Mix proportion

Water content	**Cement**	**Fine aggregate**	**Coarse aggregate**
191.6	383 (kg)	546 (kg)	1187 (kg)
0.50	1	1.42	3.09

This mix proportion of conventional concrete is taken as the reference to the EPS beads concrete. The mix proportion of EPS beads concrete taken by replacing coarse aggregates.

Two mix proportions are formed and tests are taken on to EPS beads concrete mix proportion. The mix proportions for EPS beads concrete are.

Table.4: Mix proportion

TYPE I				
Water content (w/c)	Cement (kg)	Fly ash (kg)	Quarry dust (kg)	**EPS beads (kg)**
0.50	**0.5**	**0.5**	**1.5**	**3**

The mix was prepared manually. First all the dry ingredients are mixed thoroughly such as cement, fly ash, quarry dust, and EPS beads mixed by adding water after it makes uniform mixture.

Fig.1: Mixing of EPS concrete.

4.2 Placing and Compacting

Moulds are properly cleaned and oiled. The fresh concrete filled into the moulds in three layers each layers are damped at 25 blows. The entrapped air in concrete is removed by using vibrator. After the compaction, the excess mortar was removed from the mould with the help of trowel and the surface was leveled.

Fig.2: placing and finishing.

4.3 Remolding and Curing

After placing it was allowed to set for 24 hours. Samples were remolded and it was marked. Concrete samples now kept in curative tank for required time of 7days, 14 days and 28 days, after that time, concrete samples were removed from curative tank.

4.4 Testing

After testing the specimen was checked for cracks, EPS beads distribution. The results of compressive strength test were given in chart 1.It was observed that, the compressive strength of all the concrete mixes increases with increase in age of concrete. It is seen that the larger the amount of EPS beads lesser the compressive strength. The conventional concrete has more compressive strength at all the ages compared to EPS beads concrete.

After curing concrete sample were taken to remove the excessive water content for the sample. Then samples are tested on Universal testing machine (UTM), available in college.

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V. TESTS ON CONCRETE

FRESH CONCRETE TEST

5.1 Workability Test (Slump Cone Test)

The slump test is used to measure the workability of fresh concrete. More specifically, it measures the consistency of the concrete.

Type	Conventional	Type I	Type II
Slump (mm)	21	26	24

HARDENED CONCRETE TEST

5.2 Compressive Strength Test

Compressive strength test of the cube was carried out on Universal Testing Machine (UTM). The load applied on specimen uniformly, without any shocks up to the specimen fails.

Fig.3: Testing on UTM.

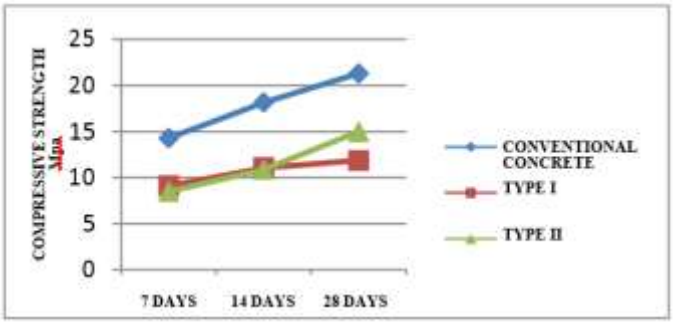

Chart.1: Compressive Strength Test Results for Specimens

5.3 Split Tensile Strength Test

Split Tensile strength test of the cylinder was carried out on Universal Testing Machine (UTM). The load applied on specimen uniformly, without any shocks up to the specimen fails. The specimen placed like the center of specimen and center of moving plates are same. A set of three cylinders are tested for each concrete mix for 7days, 14 days and 28 days of curing. The maximum load taken by specimen was noted for each specimen. Average strength was calculated for every set of specimens. After testing the specimen was checked for cracks, EPS beads distribution. The results of Split Tensile strength test were given in chart 2.

It was observed that the split tensile strength of all concrete mixes increases with increase in ages. It was seen that the larger the amount of EPS beads lesser the split tensile strength. The concrete mix proportion for TYPE B gives more split tensile strength than conventional concrete.

The specimen placed like the center of specimen and center of moving plates are same. A set of three concrete cubes are tested for 7days, 14 days and 28 days of curing. The maximum load taken by specimen was noted for each specimen. Average strength was calculated for every set of specimens.

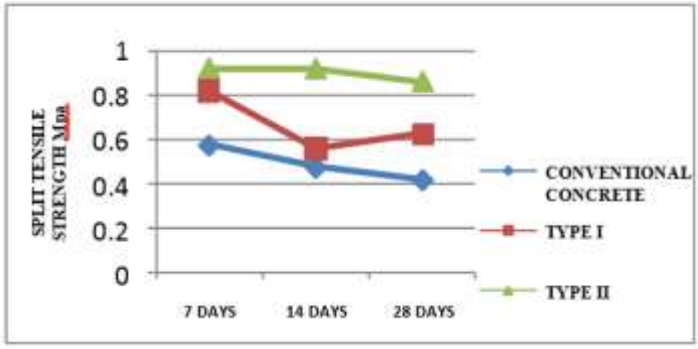

Chart.2: Split Tensile Strength Test Results for Specimens

VI. CONCLUSIONS

The following conclusions are drawn from the study.

1. Workability increase with increase EPS content and reduce the fly ash content.
2. Here, we are observed the cost of EPS concrete is lower than compared to conventional concrete.
3. Type 2 concrete sample is having high compressive strength than compared to Type 1concrete sample.
4. Fly ash added to the mixes based on 30%replacement rate on cement is reduced.
5. The concrete useful for non structural applications like pre cast concrete members, partition walls, wall panels etc.
6. EPS concrete having more workability, light weight and low thermal conductivity.

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